APPENDIX

A

Marked to Show Replacement Paragraphs

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Figure 1a shows the components of one embodiment of the invention in an exploded fashion in the order in which the components are fitted together, and Figure 1b shows the same components after being fitted together. In the embodiment shown in Figures 1a and 1b, the ultrasonic frequencies are generated by piezoelectric ceramics or crystals (not shown) contained within housing 15. As used herein, "piezoelectric ceramics" will be used to refer to piezoelectric ceramics, piezoelectric crystals, and piezoceramics. The high frequency vibrations generated by the ultrasonic generator (not shown) are enhanced by ultrasonic horn 64 which amplifies the ultrasonic vibrations that are induced by the ultrasonic generator. Resonator probe (or drill bit, floating-head probe, or drilling mechanism), hereinafter probe 11, is inserted into horn 64, which, in turn, is driven by the generator. Probe 11 is not, however, fixedly secured to horn 64, but allowed to partially disengage horn 64 by using a capturing mechanism. One embodiment of the capturing mechanism is comprised of barrier member 50 and capturing member 51.

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In the embodiment shown, barrier member 50 is closer to the end of probe 11 that is to be inserted into horn 64 than it is to the end that protrudes from capturing member 51 when assembled, but could be at any point along probe 11. Barrier member 50 is larger than opening 42 to prevent probe 11 from disengaging horn 64 completely. Barrier member 50 can be fixedly secured on probe 11 between horn 64

and capturing member 51 or probe can barrier member 50 can be constructed as one integrated piece as can be seen in Figures 5a and 5b. In addition, spring 20 can be included as part of the capturing mechanism and is shown in the embodiment of the present invention depicted in Figures 1a and 1b. Spring 20 is located between barrier member 50 and capturing member 51 and provides extra force in pushing probe 11 back into horn 64 after probe 11 disengages horn 64. In one embodiment, spring 20 is compressed to approximately one eighth of an inch (1/8"). This compression allows probe 11 to work without being under load, i.e., the device can be operated without a user having to exert a downward force against an object. In addition to spring 20, a bell-view washer or cantilever-type spring or spring-like material can be used, as can any other load mechanism known to one of ordinary skill in the art. With respect to the amount of bias in spring 20, the eighth of an inch is a little more than the length of excursion of the end of probe 11, as it travels back and forth.

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One of ordinary skill in the art should also appreciate that in addition to the materials used, free mass 101 can vary in size, shape, and weight. Exactly what size, shape, and weight chosen depends on the size of transducer horn 64, probe 11, and on the frequency output at which the device is to be operated. The diameter of ~~free mass 101~~ barrier member 50 should be at least as great as that of the ~~tip of horn 64~~ diameter of opening 42 to prevent probe 11 from being ejected through opening 42 of capturing member 51, but small enough not to scrape the side walls of capturing member 51. For applications such as drilling hardened materials, as described herein, free mass 101 is,

in one embodiment, one quarter (1/4) inch in diameter. For applications such as the removal of pacemaker leads, free mass 101 can also be one quarter inch in diameter. However, the inner diameter and outer diameter of probe 11 is dependent on the diameter of the hole size required or the diameter of the item going through the inside of probe 11 such as a pacemaker lead to be removed. Thus, the size of free mass 101, in this particular application, is also a function of the lead to be removed. In another example embodiment, free mass 101 is 5cm (five centimeters) in diameter when used for drilling and coring ice at -30 °C.

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Figures 7A and 7B show a series of tip configurations that can be used on the ultrasonic floating probe according to the application. Bits 119 can be constructed as closely-spaced, small diameter rods to allow only the selected sections of the material upon which work is being done to be chipped, or bits 119 can be smooth for slicing applications. Since bit 119 and the probe (not shown) do not <u>have to</u> rotate, drilling sensors can be integrated near bit 119 to examine and analyze the cored material without the risk of mechanical damage. One or a plurality of sensors of sensor suites can be used to examine the freshly produced surfaces, while penetrating the medium. Furthermore, the sensors can be installed in the core area to examine the cored material where emitted volatiles are sucked by a vacuum system to an analyzer (see also Figure 8). Potential sensors include temperature, eddy-current, acoustic sensors, dielectrics, fiber optics, and others. Two specific configurations, 111 and 112, are shown which have a fingered construction for coring. The fingered configuration is

particularly well-suited for coring bones, one of the possible uses of this device. It will be obvious to one of ordinary skill in the art that any type of bit 119 configuration can be used with the present invention, depending on the application, such as, but not limited to the remaining bit 119 configurations of Figures 7a and 7b.

APPENDIX B

FIGURES

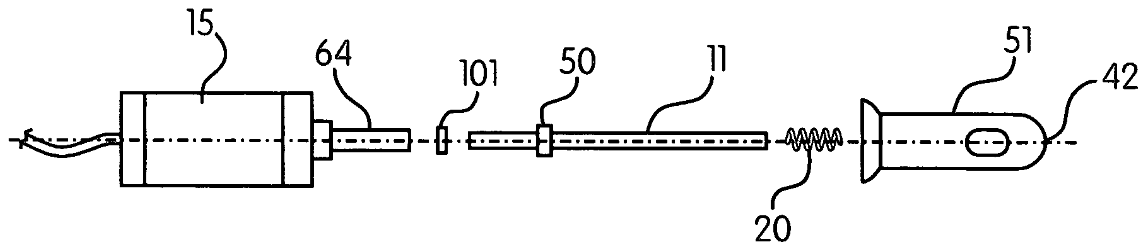


FIG. 1A

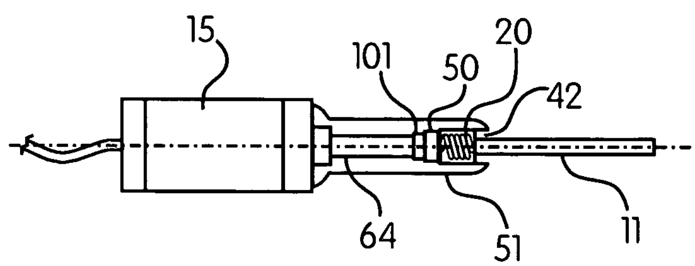


FIG. 1B

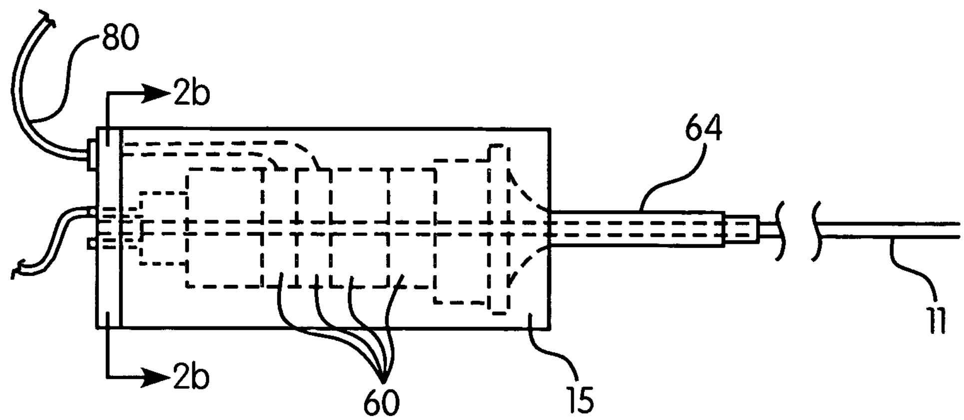


FIG. 2a

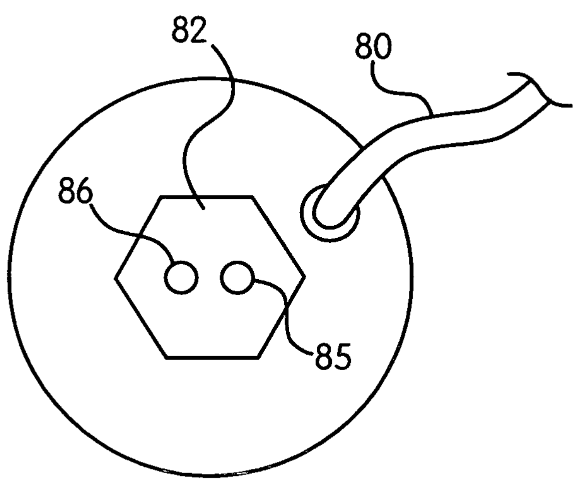
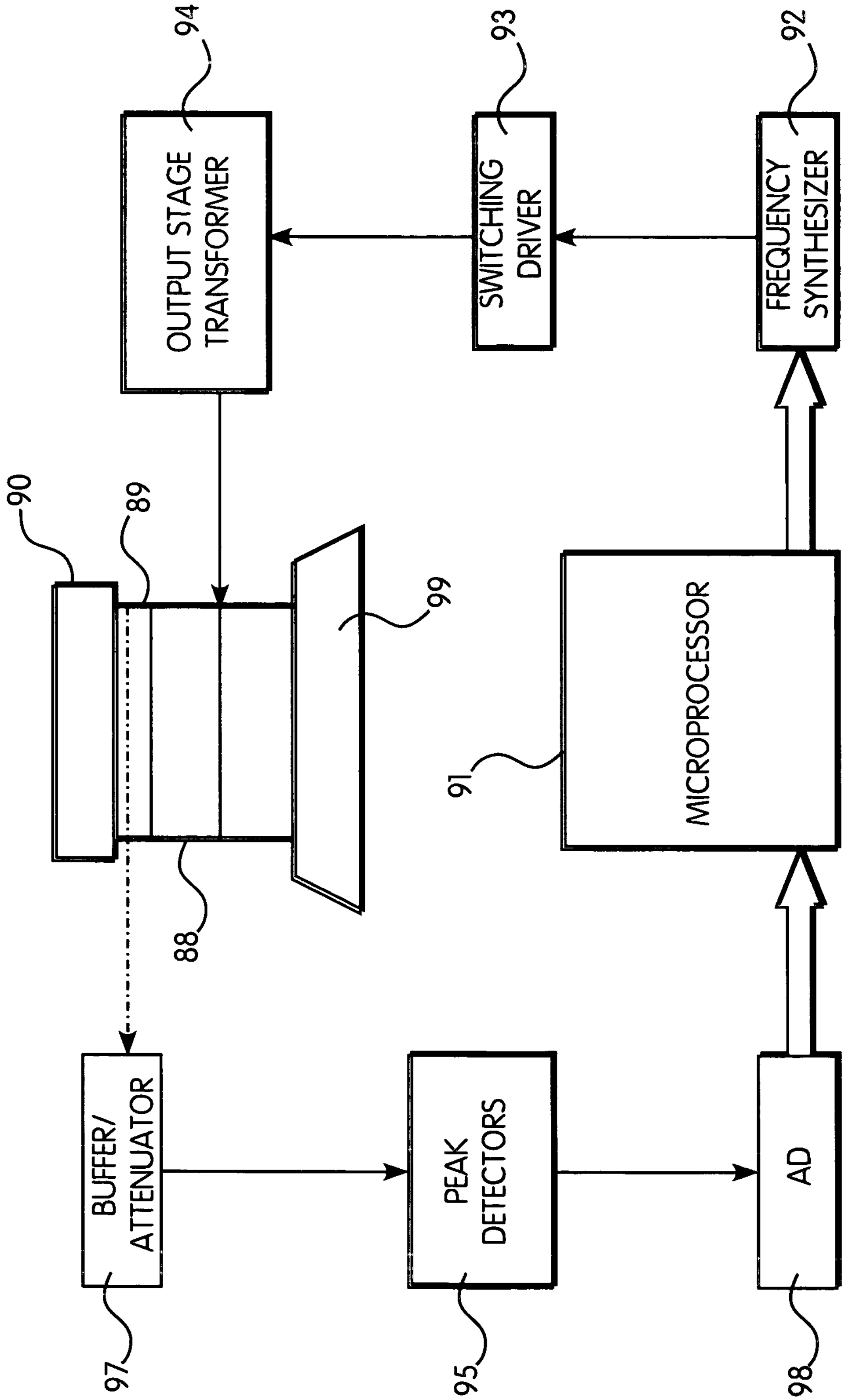


FIG. 2b



OUTPUT STAGE TRANSFORMER
94
SWITCHING DRIVER
93
FREQUENCY SYNTHESIZER
92
90
89
99
88
MICROPROCESSOR
91
BUFFER/ ATTENUATOR
97
PEAK DETECTORS
95
AD
98

FIG. 3

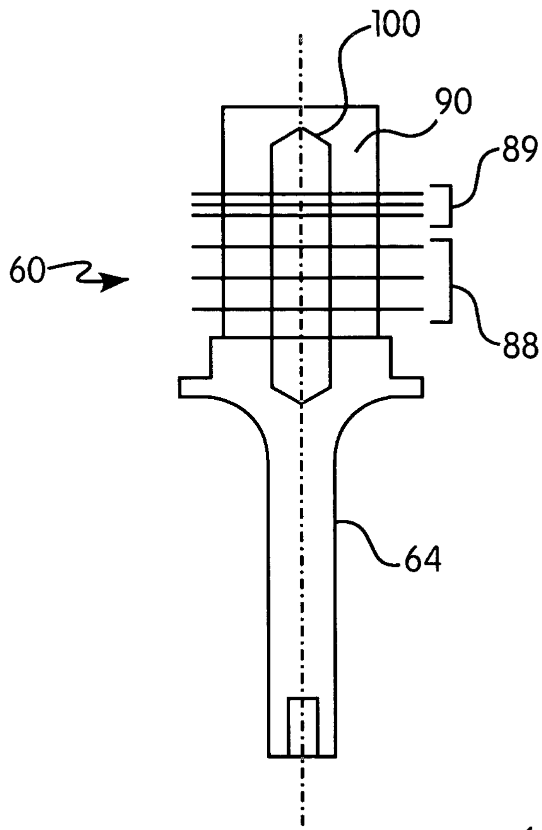


FIG. 4A

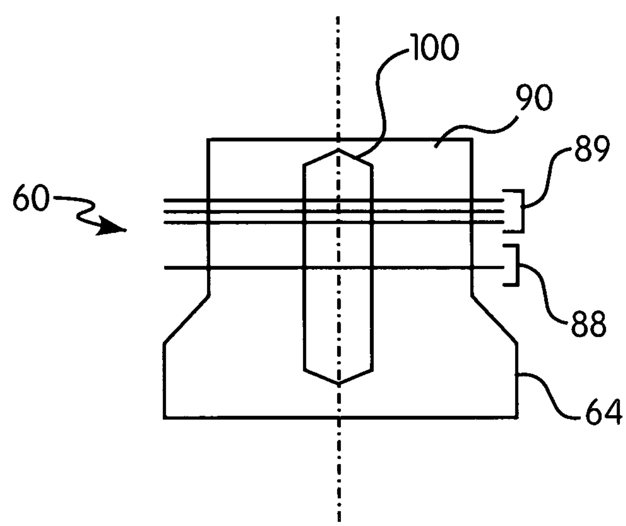


FIG. 4B

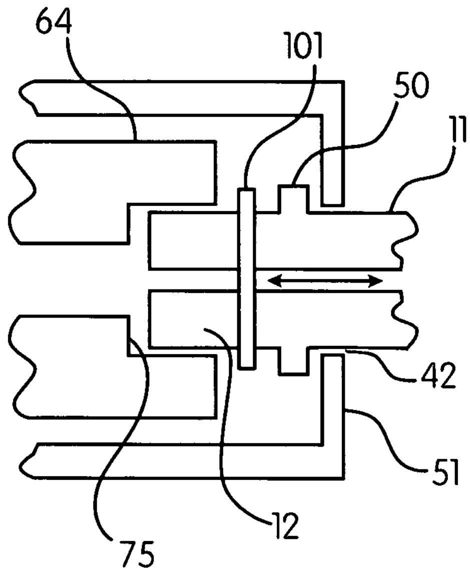


FIG. 5A

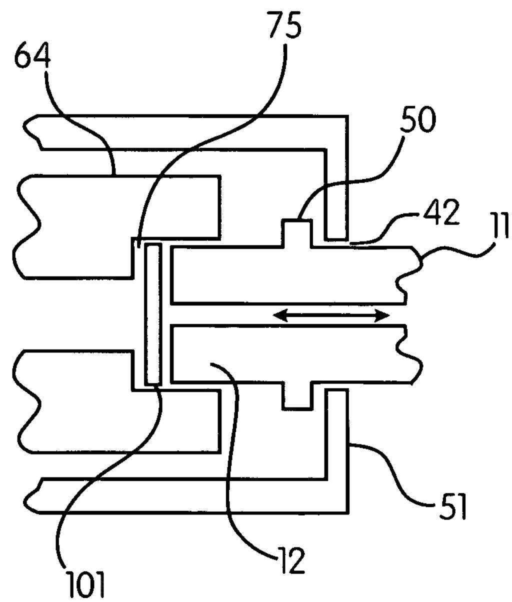


FIG. 5B

FIG. 6A

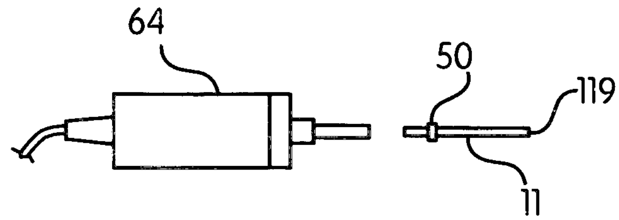


FIG. 6B

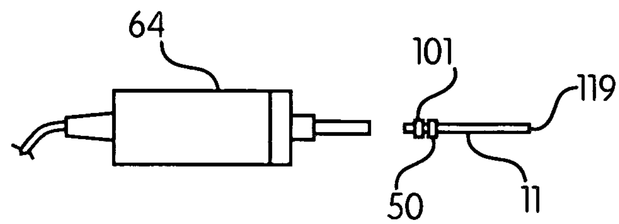


FIG. 6C

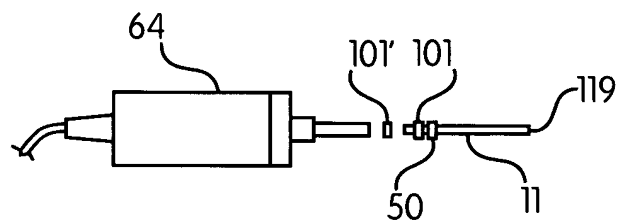


FIG. 6D

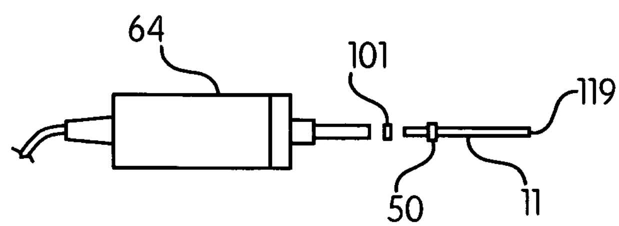


FIG. 6E

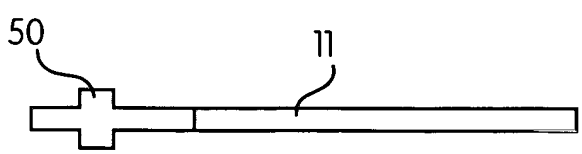


FIG. 6F

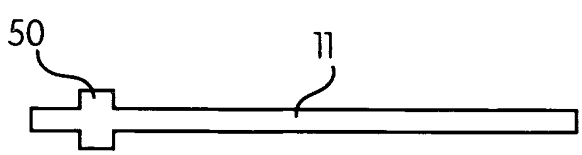


FIG. 7A

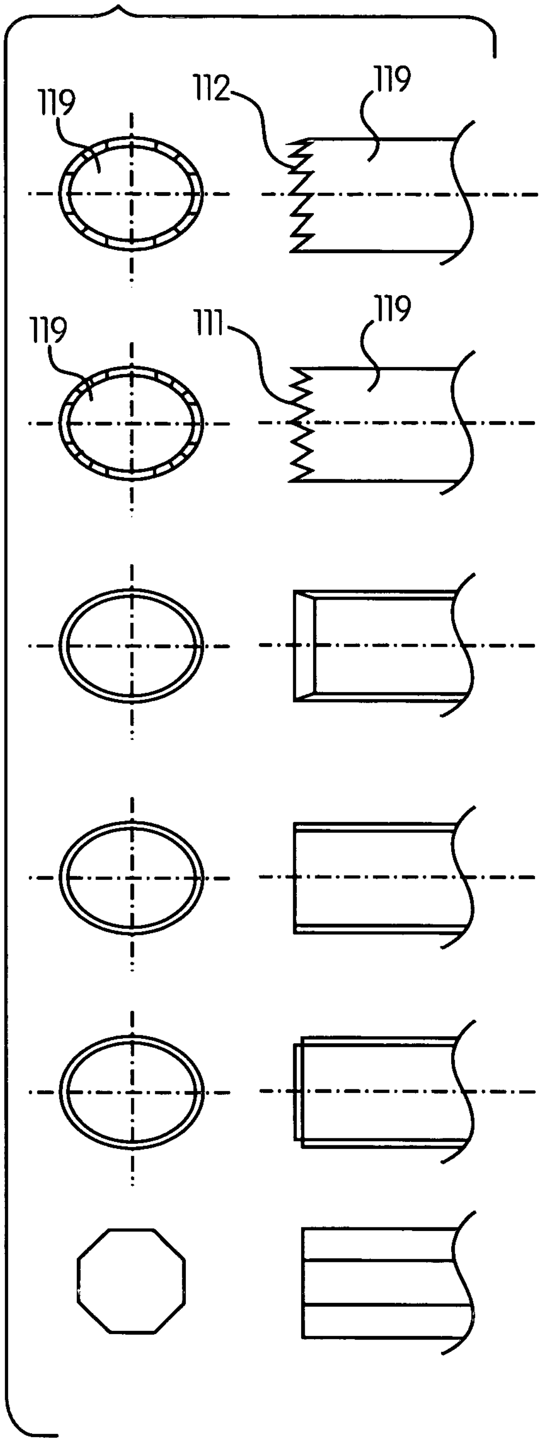
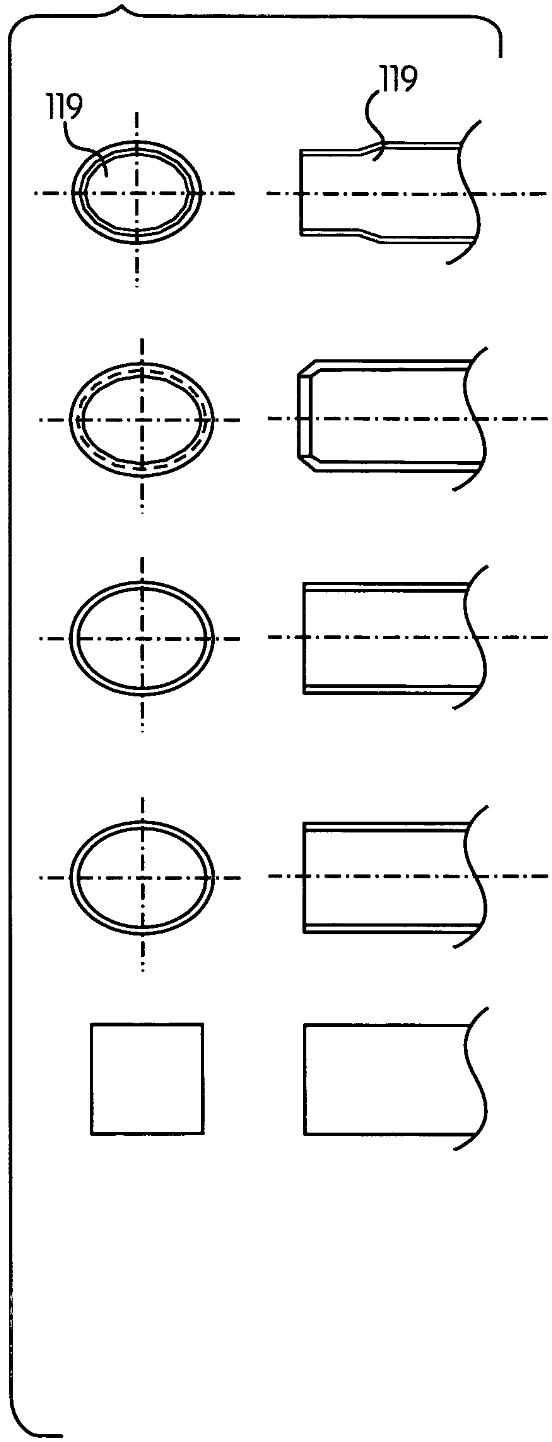


FIG. 7B



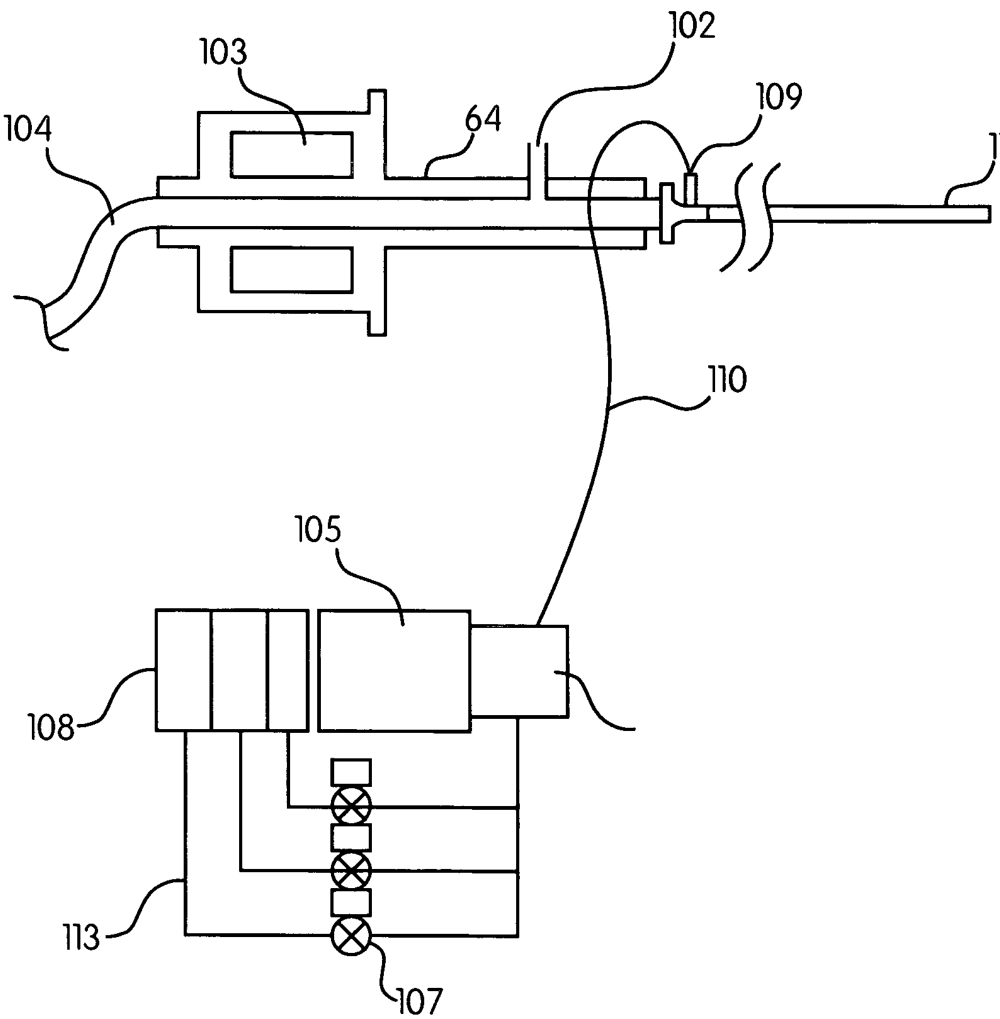


FIG. 8

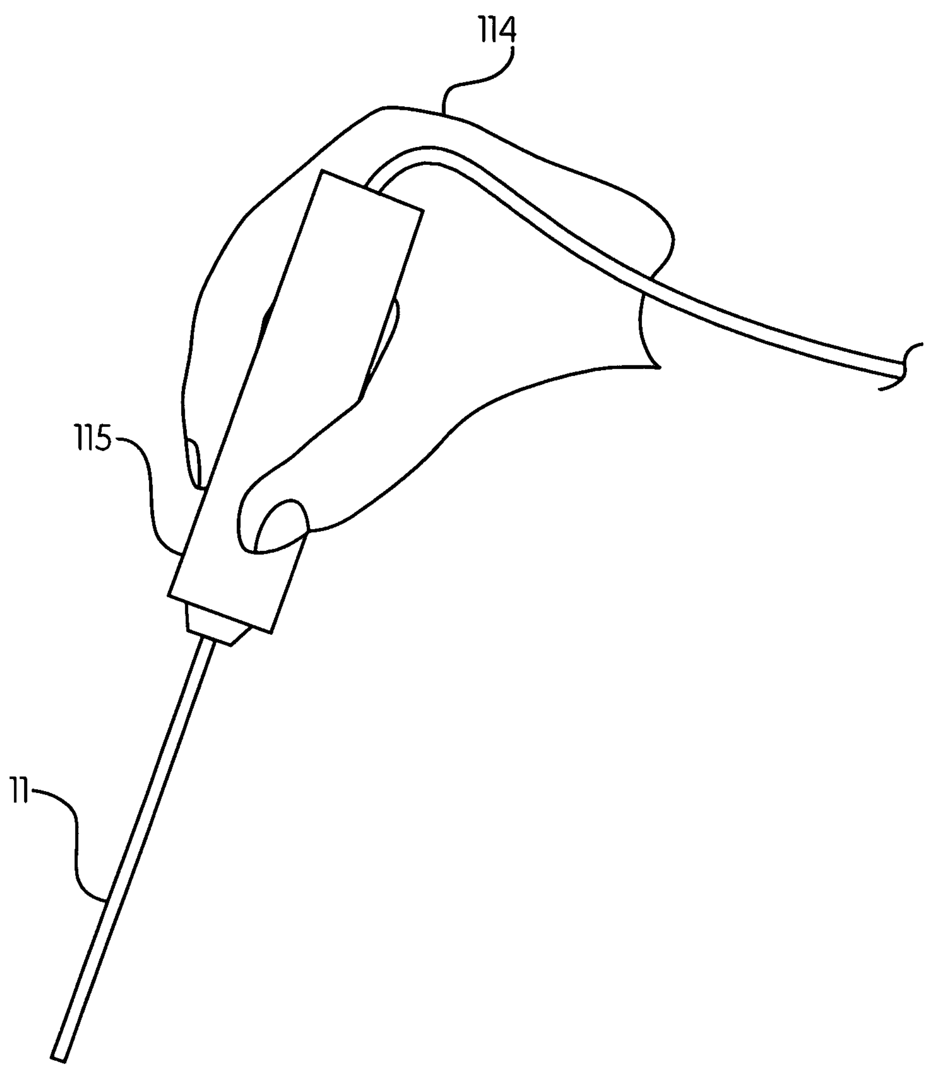


FIG. 9